Confidential Advice on Examining in Engineering and Manufacturing Engineering Tripos Examinations

This advice is provided for the convenience of Chairmen of Examiners. It is designed to help brief Examiners about some aspects of their job and must not be allowed to interfere with the official guidance issued to Examiners by the Faculty Board.

I. **The purpose of the Tripos examinations** is to determine the extent to which candidates have achieved the aims and objectives of the lecture courses. Examinations should test students on whether they:

(a) have understood the basic principles with which they have been confronted, and their limitations;

(b) have developed skills in applying basic principles to the solution of straightforward problems, and;

(c) have developed a deeper understanding, allowing them to tackle problems that are, for them, novel.

2. **Examiners should not**:

(a) attempt to show how clever they can be;

(b) attempt to provide posterity with a supply of teaching exercises, or;

(c) attempt to influence course content by setting questions that run counter to the lectures.

Examiners have a tendency to set questions which are too difficult. When a lecturer, checker, or external examiner warns that a draft question is too difficult, history shows that he or she is almost always correct. It is important for examiners to act on such comments. Examinations should be structured so that very able students will distinguish themselves above the rest and less gifted, but conscientious, students will achieve a safe II.2 level mark.

3. **The structure of questions** is very important. Questions with only one substantial point are unsatisfactory because candidates either get very high or very low marks. Questions should preferably be structured as a series of closely linked steps.

In Part I papers, the major part of each question should be straightforward, set on familiar material and free from quirks and pitfalls. Students who have attended the lectures and completed the examples papers should quickly recognise what is required. A useful format is the three-part question where candidates are asked:

(a) to provide a statement of principle;

(b) to perform a straightforward application, and;

(c) to probe more deeply a specific part of the problem.

In Part IA (a) and (b) will be sufficient. In Part IB questions may have all three parts but about two thirds of the credit should be allocated to (a) and (b). The same structure may be used in Part IIA and IIB papers but the problems here may place more emphasis on deeper understanding and the allocation of credit to the different parts of a question will reflect the change in emphasis.

If a question requires the derivation of a key equation *en route*, candidates should be specifically asked to derive it as an intermediate result. Not all is then lost in later parts of the question if they have been unable to perform the derivation correctly. Lengthy or difficulty algebraic manipulation should be avoided.

It is most important that examiners always keep in mind the time available for answering a question. They should also remember that questions are often greatly improved by including a sketch.

4. **Essay type questions** are rarely answered really well or really badly. Engineering students avoid essay questions because they know there is little chance of gaining high marks. If a question simply asks

‘Discuss the design parameters for a high-speed switching bipolar transistor’,

then mediocre answers can be expected. A much better way of structuring the question would be:

‘For a bipolar transistor:

(a) Explain the concept of minority carrier stored charge in the base.

(b) Outline the effect of current crowding at the base, indicating why it is deleterious and how these deleterious effects are combated.

(c) Explain what causes breakdown in the collector of a transistor and why an increase in the breakdown voltage increases the transit time for the relevant charge carriers.

Hence, discuss criteria for the design of a high-speed switching bipolar transistor.’

This type of structure will ensure some uniformity in the answers making for easier comparisons and better marking. It should always be possible to identify the important points expected in the answer and these should form the substance of the crib. Some open-endedness towards the end of an essay question is desirable, however, so that better candidates can display their knowledge.

5. In setting the paper, examiners should attempt to cover most of the course syllabus and no major topic should be completely omitted. Questions should be of uniform difficulty. Setters should study the papers and examiners' reports from previous years and note which questions proved satisfactory and which did not. The best indication of the work that has been covered is obtained from the course hand-outs and examples papers. Lecturers should always be consulted and shown the questions on their part of the course. In examining, one thing is certain: a totally original paper is bound to be a disaster.

6. Checkers have a most important job. They ensure that questions are valid, clearly expressed and of the correct level of difficulty. The checker must write solutions for every question independently of the setter and simply accepting an examiner's explanation without a clear understanding is unacceptable. After checking, a detailed and easily readable crib comprising the model solutions and marking scheme is prepared by the examiner in consultation with the checker.

At this stage, the examination paper and crib should be, in the view of the setter and checker, ready for market in absolutely every respect. This includes not only the length, difficulty, content, and style of each question, but also the presentation details such as layout (including diagrams), sentence structure, grammar, and punctuation. If these aspects are covered conscientiously by the setter and checker at an early stage it saves everyone a very large amount of time and work later on. The checker should not allow semi-complete draft papers to proceed to the reading meeting.

7. When marking, examiners should adhere to the scheme indicated on the examination paper and crib. If, after about 20 scripts, it appears that adjustments will be required to produce a mark distribution in line with that required by the particular Tripos, the marking scheme can be revised slightly and the scripts remarked. If major adjustments are required, the Chairman should be consulted.

When marking a large number of scripts, standards may shift slightly. It is therefore best not to mark whole scripts at a time as some candidates may get a raw deal. A better strategy is to divide the scripts into piles, then mark Q1 right through starting with pile 1, then Q2 right through starting with pile 2, and so on.

Silly arithmetical and algebraical mistakes should not normally be penalized heavily. It is very troublesome when an early minor error gets carried through a solution. In such cases, the examiner has no choice but to follow the whole solution in detail to check the correctness of the later work. Well-structured questions will avoid this waste of time.

For each sub-section of a question, the examiner should write down the marks in red ink in the right-hand margin of the script, finishing with a ringed total for the whole question. This total should immediately be copied on to the cover sheet. Each marked page should be ticked to indicate that it has been read.

No comments whatsoever should be made on the scripts. Under no circumstances should an examiner write indiscreet comments about a candidate's performance.

8. Scaling of the marks may be required by some Triposes. In such cases, the Chairman will issue instructions as to how to proceed.

9. The Data Protection Act of 1998 requires that any data retained must be communicated to students on request. The Faculty Board Office retain marks books and the students will receive transcripts giving a breakdown of their marks. Examination scripts are not normally released but any written comments made by the examiners (excluding ticks and minor notational marks) would need to be transcribed and made available. It is therefore imperative that examiners adhere to the guidelines of Section 7 above so that data can easily be made available to students who make a request under the Data Protection Act.

Professor Richard Penty, Chairman of Part IA 2017
Professor John Clarkson, Chairman of Part IB 2017
Professor Simon Godsill, Chairman of Part IIA 2017
Professor Sir Mark Welland, Chairman of Part IIB 2017
Professor Duncan McFarlane, Chairman of MET Part IIA 2017
Dr Tim Minshall, Chairman of MET Part IIB 2017